NEWS UPDATE
4 SEPTEMBER 2002

2002 SUPERCONDUCTIVITY PEER REVIEW

The annual U.S. Department of Energy's Superconductivity Peer Review was held in Washington from 15-17 July. Attended by over 160 leading researchers and industry representatives from the United States and around the world, the review program included public presentations by industry, national laboratory, and university teams, along with a workshop on cryogenic support for superconducting power equipment.

Superconductivity researchers and industry representatives learn of latest developments and share news at annual Peer Review in Washington

During the annual Superconductivity Peer Reviews, reviewers score each project, with half the score determined by an assessment of the project's performance versus plans for the year, as well as research integration with other institutions. The other half is determined by productivity - whether world-class results were produced in the past year.

A number of new developments in the superconductivity arena were reported at the Peer Review, several of which are detailed in the following three articles:

News from the 2002 Superconductivity Peer Review

Southwire Five-meter Tri-axial Cable Design

Southwire Company reports that its team continues with Oak Ridge National Laboratory (ORNL) on the development work for a five-meter tri-axial cable design. The 5m cable was delivered to ORNL earlier this summer and terminations are currently being assembled. The company reports that performance evaluation of this design is expected to be completed by the end of the year.

News from the 2002 Superconductivity Peer Review

Pirelli Provides Update on Detroit Edison Cable Project

In reports to the 2002 Superconductivity Peer Review and subsequent press releases, American Superconductor Corporation of Westborough, Mass., and Pirelli Cables and Systems of South Plainfield, New Jersey provided updates on the high temperature superconductor (HTS) cable demonstration project in Detroit Edison's Frisbie substation.

Pirelli presented a status report on its analysis of leaks it had detected in the thermal insulation system, or cryostats, in the HTS cables. Pirelli reported that after extensive testing of the three HTS cables it installed at the Frisbie substation it has determined that leaks in two of the cables are significant enough that they cannot be energized. Pirelli also announced that it plans to continue the demonstration project with the one HTS cable that has minimal leaks after conducting further tests to ensure the stability of the leaks in this cable. If further testing goes as planned, Pirelli intends to energize the HTS cable by the end of the year.

"While a lot has been learned during the course of this project, we are disappointed that the full cable system will not be demonstrated," said Greg Yurek, chief executive officer of American Superconductor in a press release. "One positive outcome of this

Detroit Edison's Frisbie Substation

demonstration project is that American Superconductor's HTS wires met or exceeded performance specifications, as determined on samples taken from the cables that had been installed in Frisbie. Based on the learning from this project and from other HTS cable projects being conducted around the world, and on the excellent performance of our HTS wires, we are confident that HTS cables will continue the march to full commercialization."

Pirelli had successfully demonstrated cable cryostats in the past, and at least three other cable manufacturers have successfully demonstrated HTS cables during the last year. "These demonstration projects are providing the foundation for future commercial HTS cable success," continued Yurek.

American Superconductor reports that in addition to the Pirelli demonstration project in Detroit, HTS cable demonstration projects have been led by four other cable manufacturers during the last year: Sumitomo Electric Industries (Japan), Southwire Company (U.S.), NKT Cables (Denmark) and Condumex (Mexico). Additional HTS cable projects are currently in the planning stage in the U.S., Europe, China, Korea, Mexico and Japan. AMSC reports that it is "well positioned to become the HTS wire supplier for these future cable demonstrations based on its ability to produce high-performance HTS wire in commercial quantities."

From Pirelli press release at http://biz.yahoo.com/prnews/020718/chth025_1.html and AMSC press release at http://www.amsuper.com/press/2002/Detroit_Update.pdf.

News from the 2002 Superconductivity Peer Review

Intermagnetics' Superpower Subsidiary Reports Substantial Progress Toward HTS Production Goals

—Significant Gains Seen In Approaching Commercial-Level Manufacturing of Second-Generation High-Temperature Superconductors; HTS Transformer Expected to be Installed Early Next Year at Waukesha Electric Plant

At the 2002 Superconductivity Peer Review in Washington, Intermagnetics General Corporation's Energy Technology subsidiary, IGC-SuperPower, reported substantial progress in efforts to ultimately produce devices designed to provide more efficient, reliable and environmentally responsible solutions for transmission and distribution of electric power. SuperPower is currently developing commercial-level manufacturing capabilities for second-generation high-temperature superconductors and is collaborating with Waukesha Electric Systems to develop a 5/10 MVA HTS transformer that is intended to power Waukesha's main manufacturing facility in Wisconsin.

"We remain on target to achieve our 2002 calendar year milestone of producing HTS tape rated at 100 amp-meter in greater than one-meter lengths, as well as a target of 1000 amp-meter performance in greater than 10 meter lengths by the end of calendar 2003"

said Philip J. Pellegrino, Intermagnetics' sector president-Energy Technology. "These targets are consistent with our previous projections to achieve commercial production of second-generation HTS conductor by mid-decade."

Pellegrino also noted that SuperPower is nearing completion of its portion of work on the Waukesha transformer and that the goal for 2003 is to complete functional demonstration and testing as an integral part of Waukesha's power delivery to its main manufacturing plant. He added that "Since demonstrating continuous tape processing in our second-generation HTS pilot manufacturing facilities in January, the performance and the length of HTS tapes we have processed has steadily improved."

IGC-SuperPower is collaborating with Los Alamos and Argonne National Laboratories in efforts to scale up second-generation HTS manufacturing. SuperPower holds exclusive licenses in the relevant process technology with Los Alamos.

[From IGC-SuperPower press release]

News from the 2002 Superconductivity Peer Review

Progress in Critical Currents With RABiTS and YBCO Tapes

Marty Rupich of American Superconductor reported critical currents of 118 A with a standard deviation of less than 3% over 1-meter length of centimeter-wide RABiTS tape using a solution based MOD (Metal Organic Decomposition) process. He also showed a histogram of the average critical current of 100 A from each of 10 consecutively processed 1-meter tapes, reporting that all the reported critical currents were measured at liquid nitrogen temperatures of 77 K and self-field.

In addition, Jonathan Storer of 3M Company described his company's production of two meters of YBCO tape with critical current exceeding 40-amperes.

SOUTHWIRE REPORTS "OUTSTANDING RELIABILITY" WITH SUPERCONDUCTING CABLE PILOT PROJECT
—Pilot Project Logs Over 16,500 Hours On-line in "Real World" Application

Southwire Company of Carrollton, Georgia, reports that its superconducting pilot project (see "Superconductivity News Update" of 20 July 2001) continues to operate with "outstanding reliability." According to the company's project manager David Lindsay, "as of 28 August, the system has provided 100% of the required power to the Southwire manufacturing complex [in Carrollton] for over 16,500 hours." Lindsay adds that the "cable system has operated in a fully automated mode for 14 months…Southwire has no plans to decommission this site."

EPRI TRANSMISSION EXPERT CALLS SUPERCONDUCTIVITY "IMPORTANT NEW TECHNOLOGY FOR GRID"
—Damsky Says that "Superconductivity and DC are natural partners"

In its June 2002 issue, Electric Light & Power (EL&P) magazine interviewed Ben Damsky, EPRI project manager for transmission and substations, on the "AC vs. DC" debate which has taken place since "the earliest days of electric power, going back to that golden era when Edison and Westinghouse duked it out."

In the EL&P interview, Damsky discusses the merits and strengths of AC and DC, pointing out that each method of transmission has important applications and that nowadays DC is a true complement to AC systems rather than a rival.

When asked by EL&P about "what lies ahead [for transmission technologies]," Damsky replied that "[s]uperconductivity and DC are natural partners." Damsky points out that cables will have to be used for superconducting power transmission [rather than overhead lines] because of the liquid nitrogen cooling required and that for longer lines, DC will need to be used, adding that "when you run AC through a superconductor the losses are very low, but with DC they're zero." Finally, Damsky concludes by saying "[w]ith no resistance, a grid based on DC superconducting cable could operate at something like 20 or 50 kV, not 500 kV as now. And that means you're going to deliver a lot of current. It's certainly decades off, but if we can make it happen it will be a tremendous advance."

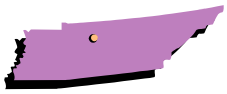
THREE SUPERCONDUCTING PROJECTS CHOSEN FOR DOE STATE ENERGY PROGRAMS

Secretary of Energy Spencer Abraham announced on 9 July that the Department of Energy (DOE) will provide $12,608,524 to 47 states and three territories for 138 energy efficiency and renewable energy projects. The department is providing the funding through its State Energy Program Special Projects competitive grants.

"These special energy projects will help conserve energy, provide jobs, increase our national energy security and reduce the need for new electricity generating plants," Secretary Abraham said. "President Bush's National Energy Policy recognizes the important role states play in promoting energy efficiency and renewable energy strategies."

Three of the selected projects, in Tennessee, New York and Pennsylvania, involve high-temperature superconductivity, and are summarized below.

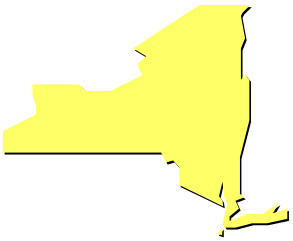
Tennessee Technological University, Center for Electric Power, Cookeville, Tennessee
"Feasibility of Electric Power Transport by DC Superconducting Cables in Tennessee"



Summary Description [provided by grantee]: The demand for transmission of large blocks of electric power and the constraints for building high voltage overhead power lines have focused attention to power transmission by underground cables. The development of high-temperature superconductors (HTS) in the 1980s and the expected unprecedented power demand have given new impetus to the development of superconducting cables. Although there are several ongoing projects on AC superconducting cables, there is no project on DC superconducting cables at present. DC power lines are generally used to interconnect AC systems. Therefore, converters are required at both ends of a DC line. DC transmission has become more competitive because of development of new types of converters. The DC superconducting cable has the following advantages over its AC counterpart: (i) it has no conductor and dielectric losses; (ii) its power transfer capability is not constrained by the system stability limit; (iii) its short-circuit current is significantly lower than that in AC; and (iv) three DC cables in bipolar mode are equivalent to six AC cables for reliability and contingency requirements.

An eighteen-month project is proposed to study the following, with special emphasis on the potential benefits of a DC high-temperature superconducting cable system in Tennessee: (i) preliminary design for monopolar/bipolar operation; (ii) compatible converters at the cable terminals; (iii) technical advantages and disadvantages, such as short-circuit current, losses due to harmonics if any, transient overvoltages, and reactive power compensation; (iv) preliminary economic evaluation; and (v) future course of action. We propose to collaborate with the various distributors of electric power in Tennessee as well as with the national laboratories which have large superconductor projects.

State University of New York, Energy & Environmental Technology Applications Center
University at Albany, Institute of Materials State University of New York
"Superconductivity Outreach and Planning"



Summary Description [provided by grantee]: The University of Albany, New York State Energy Research and Development Authority, and Energetics, Inc., will organize a series of outreach meetings to disseminate information on the technical, economic, and environmental benefits of high temperature superconducting (HTS) technologies in the electric power sector. Focus will be on HTS products supporting growth and installation of distributed power or renewable energy systems in urban areas that meet the premium power requirements of end-users. A conference will be planned to discuss market needs and cost-effective applications of these technologies. A final facilitated workshop will result in an implementation plan at the state level.

Pennsylvania Department of Environmental Protection, Office of Pollution and Compliance Assistance
"Superconductivity Outreach and Planning"

Summary Description [provided by grantee]: The Pennsylvania Department of Environmental Protection, along with Energetics, Inc., will organize a series of outreach meetings to disseminate information on the technical, economic, and environmental benefits of high-temperature superconducting technologies in the electric power sector. A conference will be planned to discuss market needs and cost-effective applications of these technologies. A final facilitated workshop will result in an implementation plan at the state level.

DOE ISSUES SOLICITATION FOR UNIVERSITY RESEARCH PROJECTS
— New Solicitation Teams Proposing Universities, National Laboratories on Coated Conductor Research

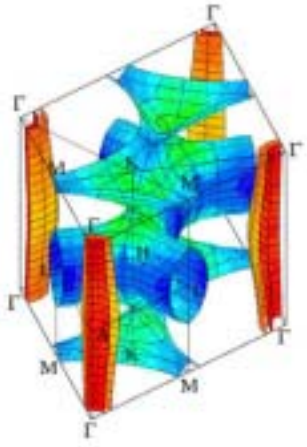
On 15 August, the U.S. Department of Energy's Idaho Operations Office (ID) announced that it is seeking applications for university research projects in partnership with a national laboratory in support of the High Temperature Superconductivity Program to expand the research base. The research must support Superconductivity for Electric Systems Program milestones, research objectives, and long-term goals.

For more information on this opportunity, visit
http://e-enter.doe.gov/iips/busopor.nsf/8373d2fc6d83b666852564520079 63f5/d005d4e0845ca01885256c16005e2ecf?OpenDocument

A MOST UNUSUAL SUPERCONDUCTOR AND HOW IT WORKS
—First-principles Calculation Explains the Strange Behavior of Magnesium Diboride

Magnesium diboride (MgB2) becomes superconducting at 39 degrees Kelvin, one of the highest known transition temperatures (Tc) of any superconductor. What's more, its puzzling characteristics include more than one superconducting energy gap, a state of affairs anticipated in theory but never before seen experimentally.

Now theorists at Lawrence Berkeley National Laboratory and the University of California at Berkeley, led by Marvin Cohen and Steven Louie of Berkeley Lab's Materials Sciences Division, both professors of physics at UC Berkeley, have calculated the properties of this unique superconductor from first principles, revealing the secrets of its anomalous behavior. Collaborators in the project included



The size of superconducting energy gaps changes greatly on different sections of MgB2's complex Fermi surface.

postdoctoral fellow Hyoungjoon Choi, graduate student David Roundy, and visitor Hong Sun.

In the August 15 issue of Nature, the theorists report that MgB2's odd features arise from two separate populations of electrons -- nicknamed "red" and "blue" -- that form different kinds of bonds among the material's atoms. As well as explaining conflicting observations, their calculations led to predictions subsequently born out by experiment. Further, they suggest the possibility of creating radically new materials with analogous electronic structure.

"The origin of the anomalous superconducting properties of MgB2," by Hyoung Joon Choi, David Roundy, Hong Sun, Marvin L. Cohen, and Steven G. Louie, appears in the 15 August 2002 issue of Nature.

[From press release at http://www.lbl.gov/Science-Articles/Archive/MSD-superconductor-Cohen-Louie.html]

CONDUCTING/INSULATING MATERIALS REVEAL THEIR SECRETS

Physicists at DOE's Brookhaven Lab have provided new insight into why some oxide materials composed of stacks of metallic planes are conductors in the planes but insulators perpendicular to the planes. The scientists found that this dual property was due to the presence or absence of strongly interacting electrons within the planes. Below some temperature—which varies between -100 and -300 degrees Fahrenheit, depending on the material—electrons within the planes no longer interact strongly with each other, and are free to move within and between the planes, allowing the material to conduct in all directions. These results will help scientists gain new insight into superconductors—materials that conduct electricity with no energy loss.

[From DOE Pulse of 24 June 2002]

MCT ANNOUNCES CCVD RABiTS™ BUFFERED TAPES FOR USE IN SECOND-GENERATION HIGH TEMPERATURE SUPERCONDUCTORS

MicroCoating Technologies (MCT) of Atlanta has demonstrated fabrication of high quality buffer layers on textured metal tapes for use in the fabrication of second generation high temperature superconductors. In a 20 June announcement, MCT says that these buffered tapes, which are now available for purchase, are produced by Combustion Chemical Vapor Deposition (CCVD) on Rolling Assisted Biaxially Textured Substrates (RABiTS™). YBCO films deposited by pulsed laser deposition (PLD) on CCVD RABiTS™ templates have demonstrated the benchmark critical current of greater than 1MA/cm2. The architecture used to reach this key benchmark was a ceria capped strontium titanate buffer layer approximately 250 nm thick with an effective thickness of the superconducting layer also approximately 250 nm.

According to MCT, the new technique is based on the company's innovative and proprietary flame based, non-vacuum CCVD process and Nanomiser™ atomization technology. The major advantage of the CCVD process to these buffer layers is the ability to produce long lengths in a non-vacuum, reel-to-reel system at a much lower cost in production than traditional vacuum-based systems. In addition, the buffer layers are grown with a high degree of epitaxy and uniformity over meter lengths. The Nanomiser™ atomizer facilitates the atomization of a solution into sub-micron droplets that are combusted in the flame and then deposited onto the flexible metal substrate.

Buffer layers are essential to the fabrication of HTS tapes, acting as a barrier layer between the superconductor and the metal tape. The buffer layers produced via the CCVD process have proven to be an effective barrier to the nickel oxide growth that occurs during YBCO deposition. MCT's CCVD RABiTS™ will aid in unifying the industry in research and facilitating escalation to production. The common buffer will allow superconductor techniques to be benchmarked against others, while tailoring of various buffer layers will allow for optimization of those techniques. "MCT's intention is to become the substrate of choice for HTS development and manufacturing," says Shara Shoup, director of MCT's Superconducting Wire Business Unit.

MCT licenses the RABiTS™ technology from Oak Ridge National Laboratory (ORNL), and receives textured metal and metal alloy tapes from Oxford Instruments Superconducting Technology of Carteret, N.J. Development of the CCVD RABiTS™ buffered tape technology at MCT and Oxford was funded by the U.S. Department of Energy with administration through ORNL. The two companies will also collaborate in this initial commercialization of the technology.

[From MCT press release of 20 June 2002]

AMERICAN SUPERCONDUCTOR AND GE RECEIVE THIRD ORDER FOR NEW VOLTAGE REGULATION SYSTEM
—BC Hydro to deploy D-VAR™ system to regulate voltage on a radial transmission line

American Superconductor Corporation and GE Industrial Systems, a business of the General Electric Company, announced on 9 July the sale of one of AMSC's D-VAR voltage regulation systems to BC Hydro, one of Canada's largest utilities. This marks the third sale of a D-VAR system by the GE/AMSC team.

The D-VAR, or "Dynamic VAR," system will mitigate significant voltage problems in Fort St. James, located in central British Columbia near the end of a 70 kilometer, 66 kV radial transmission line. During peak load, the line can experience voltage sags of up to 20 percent. These voltage problems are further complicated by line events such as faults, and the use of large motors in a nearby lumber mill. While the motors are starting, voltage may sag another seven percent on the 66kV transmission line. In addition, motor stalling can also potentially cause significant voltage sags.

Utilities and grid operators often face the challenge of finding ways to improve power reliability with their existing transmission and distribution infrastructure. In particular, long radial lines with widely varying loading often require support to maintain acceptable voltage levels. The D-VAR system is well suited for this type of application. The system is expected to be operating by the end of November and will regulate voltage to within the specifications established by BC Hydro, allowing for much improved power reliability to customers in the area.

[From AMSC press release. See related article in "Superconductivity News Update" of 11 June 2002: "Wind Energy to Benefit from Greater Voltage Stability."]

RAND Discusses New Study on Effect of HTS on Power Grid

RAND, a nonprofit institution that helps improve policy and decisionmaking through research and analysis, has recently released a new study on the effects of superconductivity on the power grid. Entitled "Strengthening the Grid: Effect of High Temperature Superconducting Power Technologies on Reliability, Power Transfer Capacity, and Energy Use" its authors are Richard Silberglitt, Emile Ettedgui, and Anders Hove.

RAND's summary of this report notes that "[t]he slow growth of power transmission systems and the large growth in demand for power have contributed to higher electricity prices and reduced reliability in a number of areas across the United States in recent years. The authors demonstrate that high-temperature superconducting power technologies can address existing problems with the U.S. electric power transmission grid, especially problems with transmission constraints."

To review sections of this report or the entire document, visit RAND's website at http://www.rand.org/publications/MR/MR1531/

MRS SUPERCONDUCTIVITY WORKSHOP EXPLORES SECOND GENERATION YBCO COATED CONDUCTORS
—Workshop Provides Overview of Second-Generation YBCO Progress

Researchers at the MRS Superconductivity Workshop discuss their ideas during the event's poster session.

The International Workshop on Processing & Applications of Superconductors, sponsored by the Materials Research Society (MRS), met in Gatlinburg, Tennessee from 31 July to 2 August. Chaired by key representatives of Oak Ridge National Laboratory, ISTEC and IGC-SuperPower, this event attracted about 100 participants from around the world.

This workshop was convened to assess long- and short-term goals and needs, starting from an evaluation of the current status, for each of the components of a typical YBCO (yttrium-barium-

copper- oxygen) coated conductor (i.e. the metallic substrate, buffer layers, and the YBCO coatings.). Bringing together an international panel of experts, the conference addressed recent advancements and developments of long-length YBCO-coated conductors and applications of high temperature superconductors. The workshop was grouped into eight sessions focusing on various YBCO processing techniques, substrate development, buffer-layer technology, characterization, and applications of coated conductors.

Conference organizers report that the development of second-generation coated conductors continues to show steady improvement towards demonstration of long length processing capabilities. Several meter length results of YBCO coated conductors based on the IBAD (Ion-Beam Assisted Deposition), and RABiTS (Rolling-Assisted Biaxially Textured Substrates) approaches were presented by participants.

For more details on the International Workshop on Processing & Applications of Superconductors and its results, contact conference chair M. Parans Paranthaman, 865-574-5045.

2002 APPLIED SUPERCONDUCTIVITY CONFERENCE DRAWS LARGE CROWD

—Houston Event Focuses on Commercial Applications of Superconductivity

American Superconductor CEO Greg Yurek addresses ASCC 2002 in Houston

From new medical and communications devices to super-efficient power systems, the science of superconductivity has enormous potential in the marketplace, according to a report released in Houston on 8 August in conjunction with a major superconductivity industry conference. With the theme "Superconductors in the Marketplace," the 2002 Applied Superconductivity Conference (ASC2002) was held from 4-9 August in Houston. It featured over 1,500 top scientists, engineers, and industrial leaders from 43 countries discussing the current status and future potential of the field. The event, hosted by the Texas Center for Superconductivity and Advanced Materials (TCSAM) at the University of Houston, is the largest conference in the world focusing on commercial applications of superconductivity.

"The use of superconductivity has made possible many important technologies, from medical devices to metrology, from sensors to accelerators. Many more are expected as the field advances," said Paul C.W. Chu, ASC2002 Chairman, President of Hong Kong University of Science and Technology, and T.L.L. Temple Chair of Science at the University of Houston. Chu, a superconductivity pioneer, established the Texas Center for Superconductivity at UH in 1987.

ASC2002 also included an exhibition of industrial products and services related to superconductivity.

MARK YOUR CALENDAR: 2003 WIRE WORKSHOP

The 11th Superconductivity Wire Development Workshop has been scheduled for 21-23 January 2003 in St. Petersburg, Florida. Sponsored by the U.S. Department of Energy's Superconductivity for Electric Systems Program, this important annual event brings together leading U.S. scientists and engineers involved in the research and development of high-temperature superconducting wire.

More information on this workshop will be posted on DOE's website soon.

ABOUT THIS UPDATE

The High-Temperature Superconductivity News Update is compiled by Bob Lawrence & Associates Inc. on behalf of the superconductivity program and is issued periodically as events warrant. Past issues are available on the U.S. Department of Energy's website at http://www.eren.doe.gov/superconductivity/library_bulletins.html.

Please let me know if you would like more information or story ideas on any of these news items involving high-temperature superconductivity---a clean and capable new electricity technology for the 21st century. If you have any other comments or questions, please let me know.

Thank you very much.

Craig Cox
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